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CONTROL OF THE POCKET GOPHER IN CALIFORNIA

BY
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CONTROL OF THE POCKET GOPHER IN CALIFORNIA

BY JOSEPH DIXON*

The damage done by the pocket gopher in California is estimated at eight million dollars a year. The depredations by this rodent are locally numerous, extend over nearly the entire state, and go on all the year. The losses, taken one by one, may be trivial, but in the aggregate they are formidable.

FEATURES OF THE POCKET GOPHER

Because most of the gopher's work is done in the dark, either underground or at night, the disastrous results of the animal's activities are better known to most people than is the animal itself. The pocket gopher is a small, chunky, short-legged, burrowing rodent, with large protruding front teeth, fur-lined cheek pouches or pockets (which are used to carry food, not dirt, and which open outside the mouth), small ears and eyes, and a short tail, often naked at the tip. The gopher averages smaller than either the common house rat or the wood or "trade" rat, but there are often great differences in size, especially between the sexes.

THE POCKET GOPHER COMPARED WITH ANIMALS SOMETIMES MISTAKEN FOR IT

	Tail	Fur	External cheek pouches	Front teeth
<i>Gopher</i>	short, 2 to 3 in., often naked at tip	harsh	always present	large, protruding
<i>Mole</i>	short, 1 to 1¾ in.	velvety	none	small
<i>Meadow mouse</i>	short, 1 to 1⅔ in.	harsh	none	small
<i>Kangaroo rat</i>	long, 6 to 10 in.	silky	always present	small

COMPARISON OF MOLE AND POCKET GOPHER

The nature and work of these two animals are frequently confused, but they differ greatly. The mole is not a rodent (gnawer) at all. It lives on animal matter (worms, grubs, and insects), not on vegetable matter. A mole may occasionally be caught in a gopher run; but the gopher is the real cause of such damage as eating potatoes and

* This contribution is revised from the original which constituted Bulletin No. 281, Agric. Exper. Sta., Univ. Calif., published July, 1917.

cutting off roots, which is sometimes attributed to the mole. The mole crowds along just beneath the surface in loose soil, leaving ridges in which numerous cracks are visible. The gopher *digs* tunnels, and the sides of these are left clean cut. During dry weather, especially, the mole often burrows deeply and throws up mounds, but these show no trace of an opening, while those of the gopher do. Many moles have been caught for museum specimens by setting Macabee gopher traps carefully in the main runs of moles (see p. 345, Special Sets).

BREEDING HABITS

The data recorded with the 2700 specimens of gophers, collected throughout the state, which are now in the University of California Museum of Vertebrate Zoology, form the main basis for the following breeding notes. Gophers have from three to twelve young in a litter. The smallest number of embryos (unborn young) found was three, the greatest twelve, while the average in twenty-eight females from many parts of the state was 5.8. There is evidence to indicate that two litters in a season are frequently raised where food is plentiful, as in alfalfa fields.

Out of eighteen female gophers taken near San Bernardino, November 7 and 8, 1916, four contained small embryos and all but two of the remainder were ready to breed. The breeding season can perhaps best be gauged by the period of growth of the alfalaria, or "filaree," which, with malva, among our native plants, seems to be the gopher's favorite food. The alfalaria is one of the earliest plants to start after the first fall rains, and the resulting nutritious food supply seems to start the gophers breeding. The nest is underground, and usually placed beneath a stump, rock pile, brush pile, or similar surface protection that will discourage badgers or coyotes from digging. The young remain in it for several weeks after birth, leaving when they are nearly one-third grown and able to forage for themselves. In plowing an abandoned field in San Diego County in the middle of January, 1911, the writer uncovered at the bottom of the furrow near a willow stump a nest containing a mother gopher and four hairless, helpless young, barely able to crawl.

The following dates show the approximate time of year when the main crop of young begin leaving the nest, though young may also be found foraging for themselves much earlier or later than these dates: southern California, March 20; San Joaquin and Sacramento valleys, April 1; Owens Valley, April 15; foothills of Sierra Nevada, April 30; northwest coast region, May 15.

WHEN TO TRAP AND POISON

Obviously, the time to combat gophers most successfully is *before* the young make their appearance in the spring. Poisoning is very effective, but hard to carry on in the dry season, especially during August, September, and October, when it is most effective, since the supply of green food is then scarcest. Trapping and poisoning are most easily carried on soon after the green vegetation starts in the early winter or spring, for the gophers are then most active. The wise old males which usually cause the trapper most trouble seem to lose their instinctive caution during the mating season, take poisoned bait readily, and often blunder blindly into traps which they would never enter at other times. Every female caught at this time, before the young are born, means the destruction of from *four to twelve* gophers for the current season.

METHODS OF DESTRUCTION

The five most effective methods of destroying gophers are: (1) poisoning with strychnine; (2) trapping; (3) flooding; (4) fumigation with carbon bisulphide; (5) for permanent relief, the encouragement and protection of the gopher's natural enemies, especially the barn owl and the gopher snake.

The solution of the gopher problem lies in a combination of two or more of the above methods, rather than in any one of them (see fig. 5). Where a large acreage is to be treated, poisoning with strychnine will be found most effective in reducing the pest. Traps are *safe*, can be used at any time, and are effective in the hands of a man who is not afraid to dig and who uses care in setting and in placing them. Trapping is especially adapted to pastures, where there might be danger of poisoning stock, and to gardens, orchards, and the banks of irrigation ditches. Carbon bisulphide should be used only when the ground is wet. Both traps and carbon bisulphide are good "follow-up" methods in getting the gophers which refuse to take poisoned bait. Land that can be successfully flooded, so as to drown out the gophers, has usually been graded for irrigated crops such as alfalfa. Flooding (irrigation) is therefore automatic, and it is comparatively easy to hunt and kill gophers which are being flooded out. A man that kills all gopher snakes and barn owls on his place will have to fight gophers, and deservedly so.

1. POISONING

The four things necessary to poison gophers successfully are: (a) an effective poison such as strychnine; (b) succulent bait that will be relished by the gopher; (c) a bait large enough that the gopher must eat it at once and not put it in his pocket and carry it away to his storehouse; and (d) placing of the bait *in the main run* with the least disturbance possible, so that the gopher can readily find it and not cast it out with the dirt, as would often be the case were it placed in an open hole or in a lateral.

In poisoning ground squirrels, it has been found that strychnine is more readily absorbed through the membranous cheek pouches, which open inside the mouth, than through the stomach. But the fur-lined pockets of the gopher which open outside the mouth do not readily absorb the strychnine. Hence poisoned bait, such as strychnine-coated barley, which is effective on the ground squirrel, is not effective on the gopher. The gopher often puts the poisoned grain in its pockets and carries it away to the storehouse, where the poison soon loses strength.

The cheapest and best method of destroying gophers, where a large territory is involved, is by the use of vegetable baits poisoned with strychnine. Such baits are easily placed in the main runways or burrows of the gopher by aid of a probe (see fig. 1). The outstanding advantage of the probing method is that the burrows can be readily located and the poisoned baits placed in them with a minimum disturbance. This is important since recent field tests have shown that where the burrows were but little disturbed the gopher's suspicions were only slightly aroused or not at all. As a result of placing the bait by aid of a probe, 40 per cent more of the poisoned baits were taken by the gophers than where the burrows were dug open and the bait placed in the holes in the usual manner. Probing is also much the quicker method. One man, after becoming familiar with the use of the probe, can treat several hundred burrows in a day. As much as five acres of heavily infested alfalfa have been gone over by one man in one day.

The great disadvantage of the probing method lies in the fact that in order to use the probe successfully the surface of the ground must be damp or wet to the depth of the ordinary gopher run—six to eight inches. *The probing method is not successful in dry soils.* It is futile to probe for gopher runs in dry adobe or any other soil which cracks upon drying, because the probe drops just as readily into a crack in

the earth as into a burrow. In cultivated fields the dry surface soil tends to run in and to fill up the hole made by the probe.

Gophers are most likely to gnaw or girdle orchard trees during late summer after the surface of the ground has become dry and green vegetation is scarce. Thus at the very season when the gopher is doing the most damage, and hence his speedy destruction is most to be desired, the probing method is of little use and the rancher must then dig down to the main runways in order to set traps or place poisoned vegetable baits, which latter are especially effective at this time of year on account of the scarcity of green vegetation.

The best time to use the probe is just after the first good winter rains and before alfalaria ("filaree") or other green vegetation becomes abundant. The rancher should poison his land thoroughly *at this time* and thus kill the bulk of his gophers with a minimum of effort and expense. On account of the abundant and continuous food supply, alfalfa fields are more difficult to treat effectively than orchards or open fields.

When several acres are to be poisoned at one time a large number of baits are required. These may be prepared according to the following government formula:

Sweet potatoes, parsnips, or carrots	4 quarts
Flour paste	$\frac{1}{4}$ pint
Strychnine alkaloid, powdered	$\frac{1}{8}$ ounce
Saccharin	$\frac{1}{32}$ ounce

The vegetables should be cut into $\frac{3}{4}$ -inch cubes. The cubes must be large enough that the gopher is unable to pocket them. Failing in this, he will usually begin to eat the poisoned bait on the spot. The strychnine and saccharin should be stirred into the cooked flour paste. It is at times difficult to secure saccharin, and in that case a couple of tablespoonfuls of heavy corn syrup may be substituted. Gophers appear to be less sensitive than ground squirrels to the bitter taste of strychnine; perhaps because they are more accustomed to eating bitter roots. After the sweetened, poisoned paste has been prepared, it should be poured over the vegetable cubes, which should then be stirred until each piece is thinly coated with it. The poisoned baits are now ready for use and should for safety be kept in a covered bucket plainly marked POISON.

The probe (see fig. 1) can readily be made by any blacksmith from a two-foot section of $\frac{3}{4}$ -inch round steel. The metal part of the probe should be pointed at the lower end and bent near the upper end to form a foot-rest which may be stepped on by the operator and thus

be of service in forcing the probe into the ground. The steel point of the probe should be quite slender to work well in hard or tight ground, but in loose sandy soil a blunter point is better. The upper portion of the probe is of wood and can be made from an old shovel handle. It should be reinforced at the base by a heavy iron ferrule.

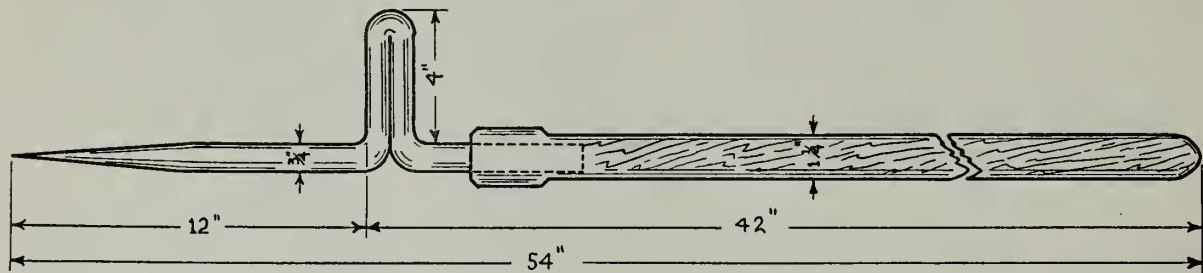


Fig. 1.—Tool for probing ground to locate underground burrows of pocket gophers.

To locate a gopher burrow sink the probe into the ground 10 to 15 inches from a gopher mound, repeating the operation until the burrow is located. This will be recognized by a sudden dropping of the probe into the open burrow. The opening made by the probe should then be enlarged, by rotating the probe or else by using the rounded end of the wooden handle, so that a poisoned cube will drop clear into the open run. After the poisoned bait has been dropped into the burrow, the hole made by the probe should be closed by the operator's heel. When a field is being poisoned the operator should kick off the tops of all gopher mounds as he goes along. If this is done, all mounds made subsequently can be readily located and re-treated, the poison being placed only where it is then needed.

Only a few poisoned baits may be necessary where a garden, nursery or lawn is being damaged by gophers. These baits may be prepared more simply as follows: Cut carrots, parsnips, sugar beets, or sweet potatoes into one-inch cubes. Then insert a few strychnine sulphate crystals into a slit in each cube, with the point of a pen-knife. Large raisins may likewise be slit and poisoned, after which they may be placed in a small bottle marked POISON and kept on hand available for use as need be. In dry ground, where the use of the probe is not practicable, the main runs of the gopher can be opened up in the same manner as when setting a trap. Then take a long slender pointed stick, so that the bait will not have to be touched, and place one of the poisoned raisins or baits a foot back in each runway, which should then be tightly closed. The hole may be opened up two days later and if the bait is gone and the hole remains open the gopher is probably dead.

Mr. H. A. Hyde, a progressive nurseryman of Watsonville, states that the following method has solved a serious gopher problem in his nursery. Dried prunes are soaked for 1 to 2 hours in water and then left to drain. An incision is then made in one end of each prune and from 1 to 1½ grains of strychnine inserted into the slit. A few drops of anise oil are placed as a lure on the other end of the prune, which is then placed well back in a fresh gopher run in the usual manner. The anise oil is smelled by the gophers at some distance and appears to be very attractive to them. The use of anise oil as a lure to rodents in general is well known.

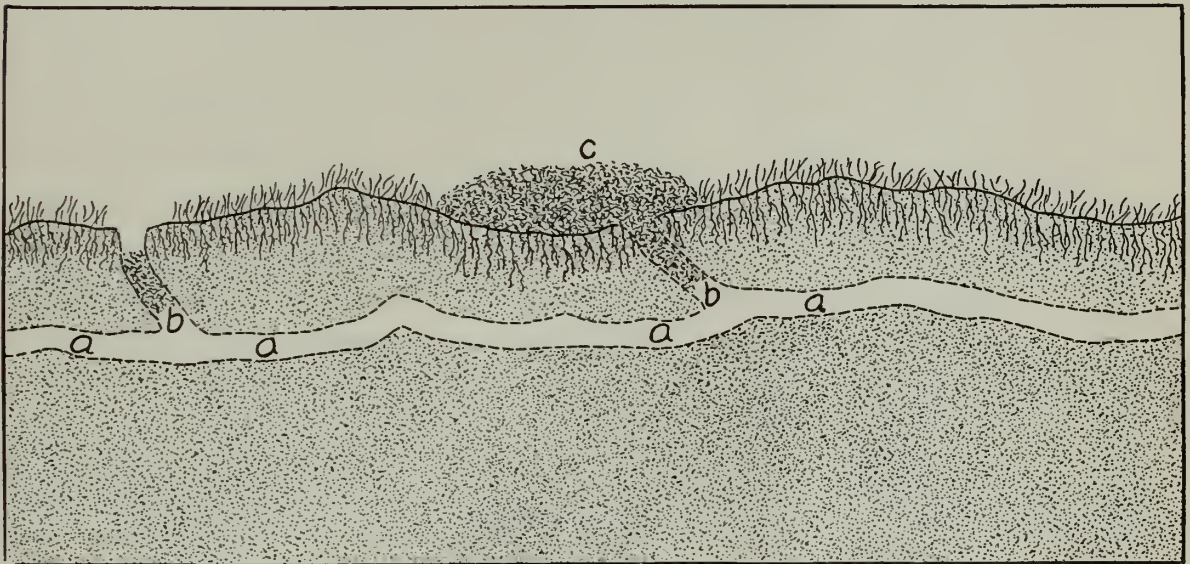


Fig. 2.—*a*. Best place to set traps or leave poisoned baits, in the main run which is always kept open by the gopher. *b*. Lateral run, usually partly plugged with dirt, leading to the surface mound *c*.

2. TRAPPING

Almost any kind of a trap will catch gophers sometimes, a few kinds will catch them most of the time, but we have yet to see the trap that will catch every gopher every time. Among experienced farmers throughout the state there seems to be a decided preference for a gopher trap of the Macabee type (fig. 3*a*). After a practical test in the field, extending over several years, the "catching average" of this style of trap has been found to equal or surpass that of any other trap that the writer has been able to secure. Its cheapness, compactness, and reliability place it at the head of the list.

Any form of explosive trap, or "gopher-gun," is not recommended because of the degree of danger which attends its use.

Where to Set the Traps

The most effective "set" for the Macabee trap is in the *main runway* (fig. 2a), and not in the lateral run (fig. 2b) that leads to the surface mound. This necessitates the use of two traps per setting, one in each direction; but the results are so much more certain and quicker that the *catch per trap per day* is greater than where but one trap is set in a lateral run where it is often filled with dirt by the gopher. A common stiff-handled twelve-inch iron spoon is of great assistance in finding the main run and in properly placing the trap. This spoon had better be supplemented by a light short-handed shovel, for digging is often necessary to get rid of gophers. The freshest mound should be selected and the probable direction of the main run determined by noting the angle of the dirt-plugged hole. The mounds are usually situated one or two feet distant from, and nearly at right angles to, the main run.

Method of procedure: Take the bowl of the iron spoon in your hand and push the other (handle) end of the spoon into the ground where you think the lateral is, which leads from the mound to the main run. If the spoon strikes an open lateral you will feel it drop through the opening. If the lateral is filled loosely with dirt the drop will be less noticeable but still plainly felt. If it is plugged tightly it will be necessary to dig down a little distance with a shovel before probing again. If this fails, try a new mound. When the lateral is found, follow it down to the main run, which is always kept open by the gopher. Use the shovel until you have cleared a place where you can set a trap in each direction. Smooth out the hole with the spoon but do not disturb it more than is necessary. Set the treadle, or pan, so that a slight touch will spring the trap, and place the trap *well back* within the hole. A little loose dirt should be left in the bottom of the hole, as it will cover the prongs and front end of the trap when the trap is pushed into place. When in place, press the trap down firmly so that it will not slide back if the gopher pushes against it. Then plug the burrow with a clod or a handful of grass or alfalfa and cover completely so that no light can get to the trap. A gopher's instinct prompts him to close tightly all open burrows to keep out his natural enemy, the gopher snake (nature's own gopher trap). Therefore, if poisoned bait or a trap be placed in an open hole, or the hole be left open, the poisoned bait will often be thrown out, to become a menace to stock, or the trap sprung by the dirt which the gopher pushed ahead of him in plugging the open hole. Set the traps and place the poisoned bait *well back in the main runs*, which should then be *tightly closed*.

The trap should have a wire or light chain attached to it and fastened to a chunk of stove-wood or, better still, an old worn-out stewpan which will rattle should you forget and run over the set trap with a harrow or cultivator. Coyotes and house-cats dislike the noise, also, and do not drag the trap far when they rob it. In case only one trap is available when the main run is found, a careful watch will often, but not always, reveal one or more little flies emerging from the run where it is first opened. These flies seem to have a direct relation to the gopher, as experiments have shown that the side that they come from is the one occupied at that time by the gopher and hence the place to set the trap. Traps should be visited morning and evening, or oftener.

Special Sets

Individual gophers will frequently be found that refuse to enter any sort of trap. These gophers are generally old males and are likely to be the ones that do most of the gnawing on fruit trees. When one of these old-timers repeatedly fills the trap with dirt, a special method becomes necessary to catch him. Moles also may be captured in this way. Take a Macabee trap (fig. 3a) and move the treadle forward about an inch and a half, placing the wire which carries the treadle *below*, instead of above, the two longitudinal wires. Cut off the wire trigger to meet this change (fig. 3b). Then bend the treadle backwards at right angles to its former position (fig. 4) so that it will lie parallel with the trap (fig. 4c), instead of sticking up at right angles and obstructing the runway (as in fig. 4b). Set the trap so that it will spring easily. Put a pinch of loose cotton under the treadle to keep the dirt out, and when the trap has been placed in the run take a stick and cover the whole trap with a thin layer of loose dirt. Another method is to take a recently caught female and rub the reproductive parts on the face of the treadle of the regular Macabee trap. A few drops of urine may be squeezed out during the process, but this only adds to the efficacy of the decoy. If all else fails catch a gopher snake and turn him loose in the run.

After you have put in poison or traps, the tops of all the gopher mounds should be kicked off, so that when you make your next round the newly made mounds will show where gophers remain and where to put out more poison or traps.

3. FLOODING

As has been pointed out above, flooding of fields is often an essential part of agriculture in irrigated sections. The main point, then, is to see to it that the gophers which are flooded out and seek the higher borders are promptly dispatched. A good dog will do this effectively until he gets tired, and then the farmer must be ready to give the gophers proper attention with the back of a shovel.

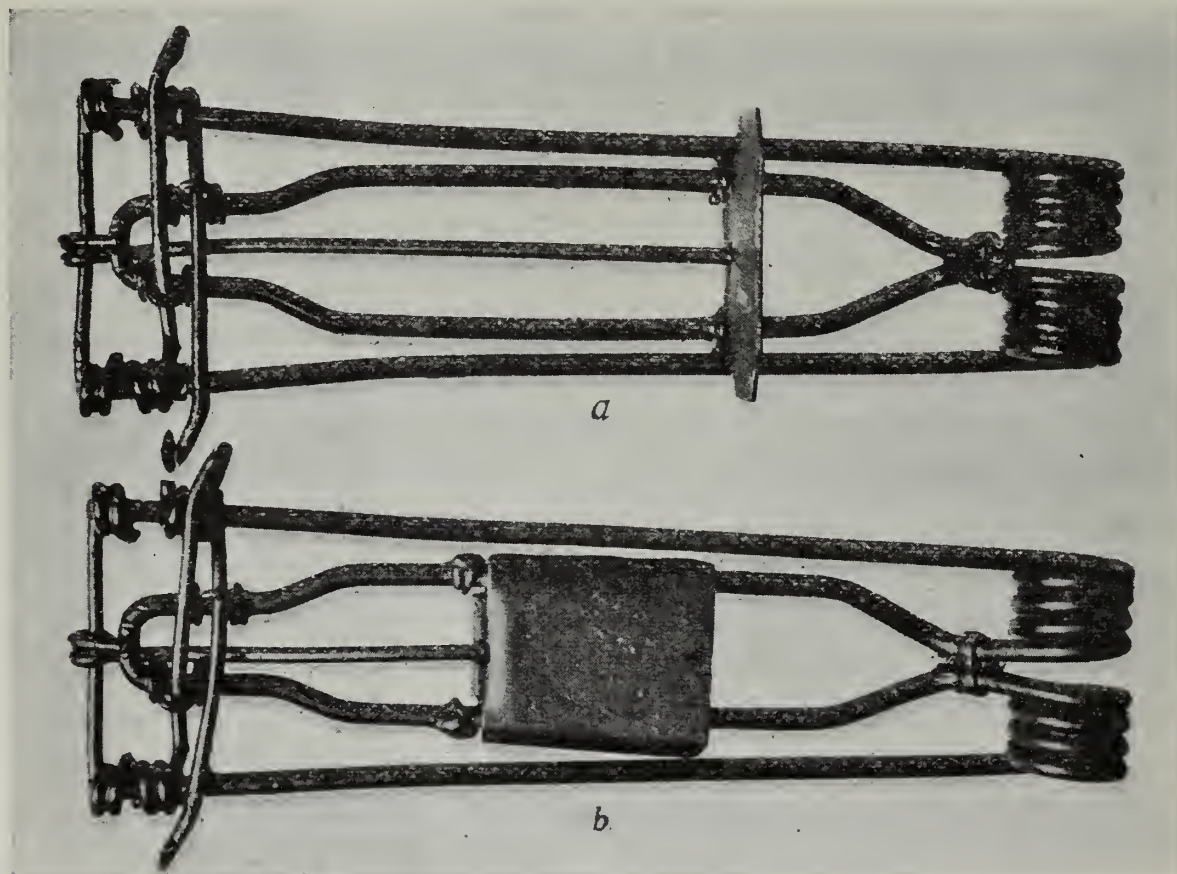


Fig. 3.—*a*. Regular Macabee gopher trap. *b*. Reconstructed Macabee trap used to catch “wise” gophers, and moles.

4. CARBON BISULPHIDE; GASOLINE

Carbon bisulphide is volatile as well as inflammable and the gas from it is explosive, so that caution should attend its use. Its use is advisable only when the ground is damp or full of water, as the cracks in dry ground let the gas escape. It does not seem to be so effective on gophers as on ground squirrels, for the gopher burrows are much more extensive and the gopher is therefore harder to reach. It is more valuable as a “follow up” method than for general application.

There are two methods of applying carbon bisulphide. The first is to pour about a tablespoonful on cotton waste, corncobs or other absorbent material, which is then quickly pushed down the hole and the opening promptly and tightly closed. The better way is by use of

a special apparatus which forces the gas down the hole. This is accomplished by a hand bellows attached to the top of a tank that contains the carbon bisulphide. The air is forced through a pipe from the bellows to the tank, where it passes over the bisulphide and is carried

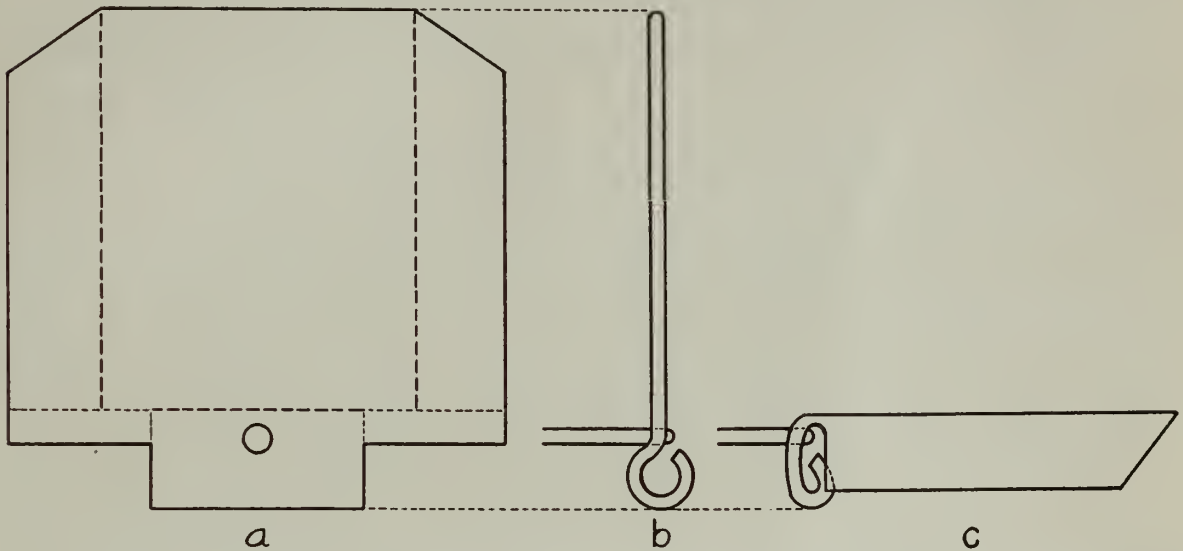


Fig. 4.—*a, b*. Vertical “treadle” or “pan” of regular trap; heavy dotted lines show places to bend vertical treadle to form horizontal treadle *c*.

out through a rubber hose which is pushed down the open hole and then tightly surrounded by dirt. Contrivances of this sort, such as the Eureka Squirrel Exterminator, are on the market. Then there are gopher “bombs” which, when lighted and placed in the burrows and covered, are supposed to generate a poisonous gas that will kill the gopher. As with carbon bisulphide, the gas often fails to reach the gopher because of obstruction and elevations in the winding burrows. Experiments have shown that with gasoline at 20 cents and carbon bisulphide at 90 cents a gallon, the bisulphide was more effective and cheaper than gasoline.

5. ENCOURAGEMENT OF THE GOPHER'S NATURAL ENEMIES

Comparatively few ranchers realize the full value of barn owls and gopher snakes as allies in their war on gophers. A pair of nesting barn owls was found by the writer to catch from three to six gophers a day for their young. No one who has ever counted the number of rodents brought in by a pair of these owls during a single season would ever doubt their value as gopher destroyers.

On May 13, 1914, near Mendota, Fresno County, Mr. John G.

Tyler* found two pairs of barn owls nesting in an old tank house. "One nest was placed in the tank on the bones, fur, pellets, and refuse that had accumulated to a depth of several inches. One bird was perched on a beam overhead asleep, while his mate occupied the nest, which contained four very small birds and six eggs. Scattered about on the floor were five pocket gophers (*Thomomys*), five kangaroo rats (*Perodipus*), one pocket mouse (*Perognathus*), and two white-footed mice (*Peromyscus*), all of which were in good condition and undoubtedly of the previous night's capture. Besides these, there were partly eaten remains and fresh skeletons of several more. . . . If the thoughtless persons who so relentlessly destroy this owl on account of its supposed fondness for chickens and pigeons would take the trouble to keep watch of a nest-site through one season, the most ignorant among them could hardly fail to realize that they are working against their own best interests whenever they kill a barn owl."

The gopher or bull snake may steal eggs occasionally, but his main diet consists of small rodents, chiefly gophers. A wise man will therefore protect the gopher snakes on his premises. *Every gopher that the barn owl or gopher snake destroys means one less for you to catch.*

OTHER METHODS OF CONTROL

Some other methods of controlling pocket gophers are: (a) protecting trees with wire netting; (b) planting gopher-repellent plants; (c) using rodent virus; (d) surrounding small plots by a trench; (e) protection of ditches by cement.

(a) *Protecting Trees with Wire Netting*

One-inch mesh galvanized wire netting in the form of a cylinder one foot in diameter and eighteen inches high may be placed about young trees when they are planted, to protect them from the attacks of gophers. The top of the netting should be put just below the surface of the ground, and the trunk of the tree above ground protected in some other way so as not to interfere with shallow cultivation, which the netting will certainly do if it sticks above ground.

(b), (c) *Gopher-Repellent Plants; Rodent Virus*

Plants which will drive gophers away, and a virus of a "gopher infectious" disease, have both been much exploited, but neither remedy seems to have "made good" and neither can be recommended.

* *Condor*, XVII, January, 1915, p. 57.

(d) *Surrounding Small Plots by a Trench*

Small plots of ground have been protected by being entirely surrounded by a trench eighteen inches wide and two feet deep, with open five-gallon cans buried flush with the bottom in the ditch at twenty-five foot intervals, to catch and hold the gophers which tumble into the ditch, and thence into the cans.

(e) *Protection of Ditches by Cement*

A power company which had much trouble with gophers in a large ditch dug a four-inch trench six feet deep straight down through the middle of the lower bank of the ditch. The dirt was loosened with an iron bar and removed with a narrow shovel of the type used in digging telephone-pole holes. The trench was then filled with a "lean" mixture of cement and sand, which was carried on a barge that floated on the water in the ditch. The cement was conveyed to the bottom of the trench by a galvanized iron chute which was built in sections so as to be readily adapted to any depth. This method was said to have been expensive, but satisfactory in the long run.

A small irrigation ditch having a seven-foot "surface" has been protected from gophers, weeds and leakage by applying to the sides and bottom, first a $\frac{7}{8}$ -inch coat of 1 to 7 cement and then a surface layer $\frac{1}{4}$ -inch thick of 1 to 3 cement. This treatment proved satisfactory.

All of these preventives are costly and are advisable only in those situations where protection against gophers cannot be obtained by their destruction.

Transmitted October 31, 1921.

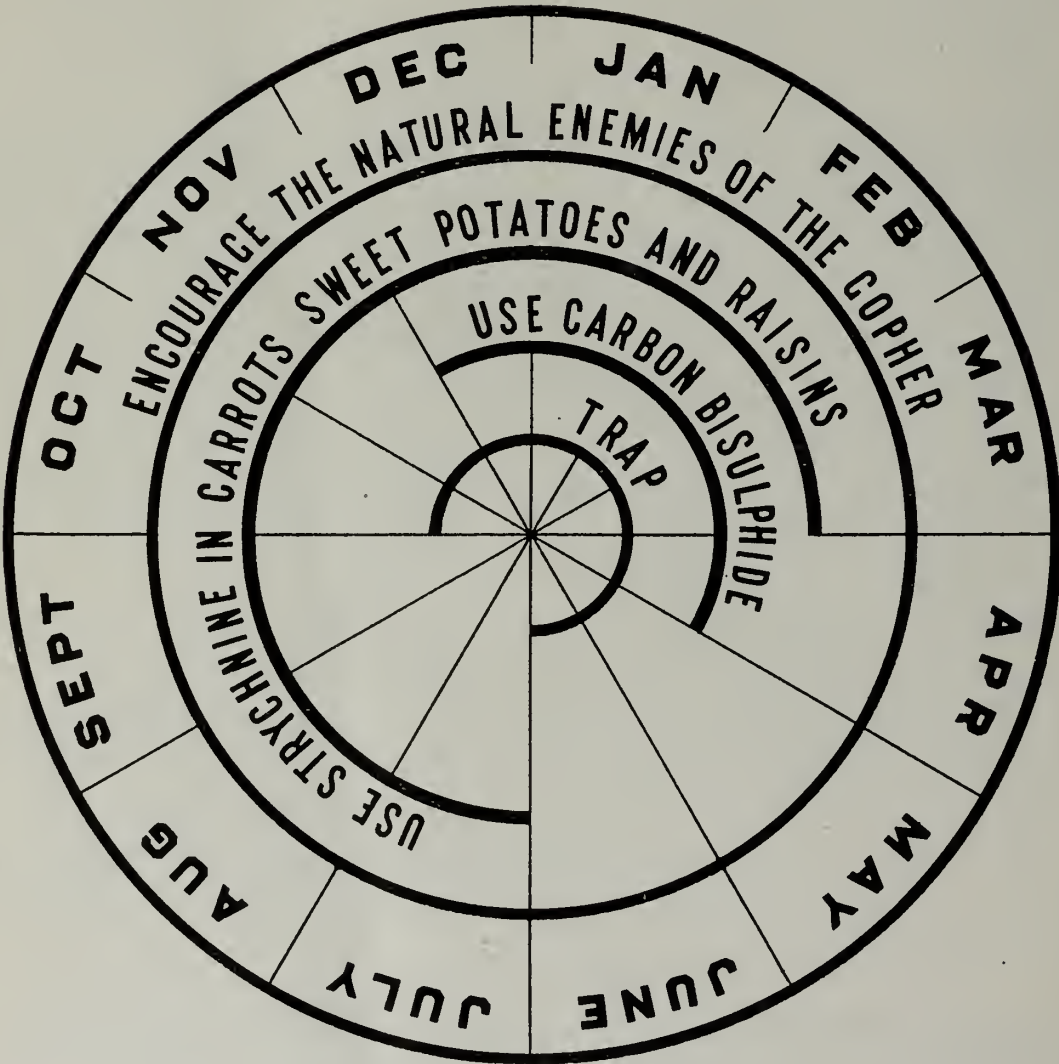


Fig. 5.—Diagram showing methods of destroying gophers to be used at various seasons of the year.